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| 10/810,718 | 03/29/2004 | Panayotis C. Andricacos | YOR920000395US3 | 8917 |
| 47939 | 7590 | 03/10/2006 | EXAMINER | |
| CONNOLLY BOVE LODGE & HUTZ LLP (IBM YORKTOWN) | | | WONG, EDNA | |
| 1990 M STREET, NW | | | ART UNIT | |
| SUITE 800 | | | PAPER NUMBER | |
| WASHINGTON, DC 20036-3425 | | | 1753 | |

DATE MAILED: 03/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/810,718

Applicant(s)

ANDRICACOS ET AL.

Examiner

Edna Wong

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 22-31 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 22-31 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 March 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>July 16, 2004</u> . | 6) <input type="checkbox"/> Other: ____. |

Drawings

Figures 1, 2, 3A and 3B should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Applicants' specification discloses that:

Fig. 1 is a SEM cross section of vias filled with electroplated copper according to prior art method;

Fig. 2 is a SEM cross section of vias filled with electroplated copper according to prior art method; and

Fig. 3 is a SEM cross section of vias filled with electroplated copper according to prior art (page 5, lines 17-24).

Specification

The disclosure is objected to because of the following informalities:

page 1, under the heading "CROSS-REFERENCE TO RELATED APPLICATION", the words -- , now abandoned -- should be inserted after the year

"2000".

page 1, line 29, the word "MANufacturing" should be amended to the word -- manufacturing --.

page 2, line 6, the word "featureand" should be amended to the words -- feature and --.

page 5, line 23, there is no Fig. 3.

page 7, line 25, the words "MAke-up" should be amended to the word -- make-up --.

page 8, line 13, the word "MArch" should be amended to the word -- March --.

Appropriate correction is required.

The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 112

Claim **29** is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 29

line 1, "the having a pH of up to about 5" lacks antecedent basis.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims **21-31** are rejected under 35 U.S.C. 102(b) as being anticipated by **Truong et al.** (US Patent No. 5,151,167).

Truong teaches an electroplating copper bath comprising:

(a) dissolved cupric salt at a concentration of at least about 0.4 molar (= 255 g/l copper sulfate);

(b) up to about 0.5 molar concentration of an acid (= 57 g/l sulfuric acid);

and

having an acidic pH (pH = 1.0) [col. 4, Table 2].

The bath is free of complexing agent (col. 4, Table 2).

The cupric salt concentration is at least about 0.8 molar (= 57 g/l sulfuric acid) [col. 4, Table 2].

The concentration of the cupric salt is at least about 0.8 molar (= 57 g/l sulfuric acid) [col. 4, Table 2].

The cupric salt comprises CuSO_4 (= copper sulfate) [col. 4, Table 2].

The concentration of the acid is about 0.1 to about 0.25 molar (col. 4, Table 2).

The acid comprises sulfuric acid (col. 4, Table 2).

The bath has a pH up to about 5 (pH = 1.0) [col. 4, Table 2].

The bath has a pH of about 1 (pH = 1.0) [col. 4, Table 2].

The bath further contains at least one auxiliary additive selected from the group consisting of brightener, leveling agent, ductility enhancer and stress reducer (= brightener, carrier or leveler, and wetting agent) [col. 5, lines 50-59].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

I. Claims **22-31** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in

combination with **Duboust et al.** ("Process Window For Electrochemical Deposition of High Aspect Ratio Structures", US Patent Application Serial No. 09/615,038, filed July 12, 2000).

Grandikota teaches an electroplating copper bath comprising:

(a) dissolved cupric salt (= copper sulfate) at a concentration of at least about 0.4 molar (= between about 30 g/l and 55 g/l, i.e., between about 0.48 M and about 0.9 M) [page 2, [0018]; and page 3, claim 1]; and

(b) up to about 0.5 molar concentration of an acid (= between about 4 g/l and about 60 g/l) [page 2, [0019]; and page 3, claim 1].

The bath is free of complexing agent (page 3, claim 1).

The cupric salt concentration is at least about 0.8 molar (= about 50 g/l) [page 3, [0023], esp., line 13].

The concentration of the cupric salt is at least about 0.8 molar (= about 50 g/l) [page 3, [0023], esp., line 13].

The cupric salt comprises CuSO_4 (= copper sulfate) [page 2, [0018], esp., line 2].

The concentration of the acid is about 0.1 to about 0.25 molar (= between about 4 g/l and about 60 g/l) [page 3, claim 1].

The acid comprises sulfuric acid (page 2, [0016]. esp., line 7; and page 4, claim 18).

The bath further contains at least one auxiliary additive selected from the group consisting of brightener, leveling agent, ductility enhancer and stress reducer (=

suppressors and accelerators) [pages 2-3, [0020]].

The electroplating copper bath of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. Wherein the bath has an acidic pH, as recited in claim 22.
- b. Wherein the bath has a pH up to about 5, as recited in claim 29.
- c. Wherein the bath has a pH of about 1, as recited in claim 30.

The electroplating copper bath disclosed by Grandikota inherently has a pH.

Like Grandikota, Duboust teaches an electroplating copper bath. Duboust teaches a plating solution comprising metal ions at a molar concentration from about 0.2 M to about 1.2 M (page 4, lines 13-14), a sulfuric acid concentration from about 45 g of H_2SO_4 per L of H_2O (0.45) to about 110 g/L (1.12 M), and having a pH less than about 2.75, preferably a pH less than about 1.6 (page 4, lines 17-18).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the pH described by Grandikota with wherein the bath has an acidic pH; wherein the bath has a pH up to about 5; and wherein the bath has a pH of about 1 because such electroplating copper baths are operated at a pH of less than about 2.75, preferably a pH less than about 1.6 as taught by Grandikota (page 1, [0001]) and Duboust (page 4, lines 17-18).

Furthermore, Duboust teaches that the pH of the plating solution affects the quality of the void free fill. Experimental data indicates that the gap fill results are

improved by decreasing the pH of the plating solution, *i.e.*, increasing the concentration of the sulfuric acid (page 7, line 30 to page 8, line 2). Thus, the pH is a result-effective variable and one skilled in the art has the skill to calculate the pH that would have determined the success of the desired reaction to occur, absent evidence to the contrary. MPEP § 2141.03 and § 2144.05(II)(B).

II. Claims **22-31** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Landau et al.** (US Patent No. 6,113,771) in combination with **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) and **Duboust et al.** ("Process Window For Electrochemical Deposition of High Aspect Ratio Structures", US Patent Application Serial No. 09/615,038, filed July 12, 2000).

Landau teaches an electroplating copper bath comprising:

(a) dissolved cupric salt (col. 3, lines 26-32) at a concentration of at least about 0.4 molar (= greater than about 0.8 M) [col. 3, lines 20-25]; and

(b) up to about 0.5 molar concentration of an acid (= up to about 0.4 M) [col. 4, lines 39-41].

The bath is free of complexing agent (col. 5, Example 1).

The cupric salt concentration is at least about 0.8 molar (= greater than about 0.8 M) [col. 3, lines 20-25].

The concentration of the cupric salt is at least about 0.8 molar (= greater than about 0.8 M) [col. 3, lines 20-25].

The cupric salt comprises CuSO_4 (= copper sulfate) [col. 3, lines 26-32].

The concentration of the acid is about 0.1 to about 0.25 molar (= up to about 0.4 M) [col. 4, lines 39-41].

The acid comprises sulfuric acid (col. 4, lines 6-10).

The bath further contains at least one auxiliary additive selected from the group consisting of brightener, leveling agent, ductility enhancer and stress reducer (= brighteners, levelers and stress reducers) [col. 5, lines 8-30].

The electroplating copper bath of Landau differs from the instant invention because Landau does not disclose the following:

- a. Wherein the bath has an acidic pH, as recited in claim 22.
- b. Wherein the bath has a pH up to about 5, as recited in claim 29.
- c. Wherein the bath has a pH of about 1, as recited in claim 30.

The electroplating copper bath disclosed by Landau inherently has a pH.

Like Landau, Grandikota and Duboust teach an electroplating copper bath.

Duboust teaches a plating solution comprising metal ions at a molar concentration from about 0.2 M to about 1.2 M (page 4, lines 13-14), a sulfuric acid concentration from about 45 g of H_2SO_4 per L of H_2O (0.45) to about 110 g/L (1.12 M), and having a pH less than about 2.75, preferably a pH less than about 1.6 (page 4, lines 17-18).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the pH described by Landau with wherein the bath

has an acidic pH; wherein the bath has a pH up to about 5; and wherein the bath has a pH of about 1 because such electroplating copper baths are operated at a pH of less than about 2.75, preferably a pH less than about 1.6 as taught by Grandikota (page 1, [0001]) and Duboust (page 4, lines 17-18).

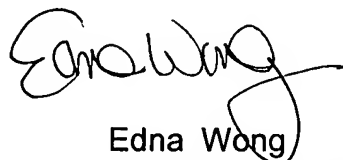
Furthermore, Duboust teaches that the pH of the plating solution affects the quality of the void free fill. Experimental data indicates that the gap fill results are improved by decreasing the pH of the plating solution, *i.e.*, increasing the concentration of the sulfuric acid (page 7, line 30 to page 8, line 2). Thus, the pH is a result-effective variable and one skilled in the art has the skill to calculate the pH that would have determined the success of the desired reaction to occur, absent evidence to the contrary. MPEP § 2141.03 and § 2144.05(II)(B).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "Edna Wong", with a stylized flourish at the end.

Edna Wong
Primary Examiner
Art Unit 1753

EW
March 7, 2006